

Fishery Data Series No. 93-37

Assessment of Catch and Effort Characteristics of the Lake Trout Fisheries in the Tanana River Drainage in 1991 From a Postal Questionnaire

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John M. Burr

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Patricia Hansen

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Alaska Department of Fish and Game

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FROM A POSTAL QUESTIONNAIRE¹

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Anchorage, Alaska

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ABSTRACT

A postal questionnaire was used to estimate the seasonal distribution of lake trout *Salvelinus namaycush* fishing effort and catch and the proportion of lake trout caught with baited and unbaited lures in the Tanana drainage during 1991. Of the 159 surveys mailed, 129 (84%) were successfully delivered and 87 (67%) of the delivered surveys were completed and returned. Forty of the returned surveys (46%) indicated that they fished for lake trout in 1991. The greatest proportion of fishing effort (0.827) occurred during the open water season. Similarly, the greatest proportion of the lake trout catch (0.868) came from summer angling. The proportion of lake trout caught with baited terminal gear during the ice-covered season was 0.545, whereas the proportion of lake trout caught with baited terminal gear during the open water season was 0.077. Although baited lures were important in the winter fishery, they accounted for only a small proportion (0.132) of the annual catch.

KEY WORDS: lake trout, *Salvelinus namaycush*, management, postal survey, ice fishing, fishing effort, catch.

INTRODUCTION

Information is scanty on the seasonal distribution of fishing effort and catch, and on the terminal gear used to catch lake trout *Salvelinus namaycush* in Alaska. Redick (1967) reported that lake trout fishing in the open water season is concentrated in spring and late fall, with sharply reduced effort and catches midsummer. Although winter ice fishing for lake trout is popular, essentially no information is available on catch and effort by ice fishermen. The only harvest, catch and effort information available for lake trout comes from the Alaska Statewide Harvest Survey (ASHS; Mills 1992). The harvest and catch data are not partitioned by season and the proportion of the total fishing effort directed toward lake trout is unknown. Knowledge concerning fishing effort is critical to successful management because effort has been found to be the most important single factor in determining lake trout harvest (Goddard et al. 1987).

In 1987, regulations were adopted which reduced the daily bag limit from 12 to 2 lake trout per day in the Tanana River drainage. In some popular road side lakes, an 18 inch minimum length limit was also adopted. For the Tangle Lakes, a more restrictive one fish daily bag limit was selected. These management actions were aimed at limiting lake trout harvest to the yield guideline of 0.5 kg/ha/yr suggested by Healey (1978). In most cases, these regulations have been successful in regulating harvest of lake trout to acceptable levels. However, there are some fisheries, such as at Fielding Lake, where the restrictions imposed in 1987 have not been as effective as desired in controlling harvest of lake trout. Lack of information regarding characteristics of the lake trout fishery in the Tanana River drainage has hampered efforts to write regulations which would effectively limit harvest of lake trout while continuing to provide fishing opportunity.

Management of lake trout fisheries is based on the control of effort through season and area restrictions and control of catch and harvest with gear and bag regulations. Knowledge of the distribution of effort and catch between seasons, and the kinds of gear that successful anglers use, will greatly enhance the ability to draft management regulations that have a high probability of being effective at regulating catch and harvest of lake trout.

This project obtained information on specific attributes of the lake trout fisheries within the Tanana River drainage with a questionnaire. The questionnaire was mailed to respondents to the ASHS who indicated they caught or harvested lake trout in the Tanana River drainage from 1987-1991. The specific objectives of this study were to:

1. estimate the proportions of angler days directed at catching lake trout with: 1) two types of gear (unbaited artificial lures and baited lures); during two seasons (open water versus ice covered seasons); and,
2. estimate the proportions of lake trout catch from waters inhabited by indigenous lake trout populations taken with: 1) two types of terminal gear (unbaited artificial lures; and, baited lures); and, 2) during two seasons (open water versus ice covered seasons).

METHODS

Sampling Design

The parameters estimated in this investigation were calculated based upon input derived from a questionnaire mailed to sport fishermen. The primary sample unit used in the project was the household which was treated as a cluster. Questionnaires were sent to all resident anglers who indicated that they fished for lake trout in the Tanana River drainage at some time since 1987. These names (license numbers) were obtained from five years of survey data from the ASHS (1987 through 1991).

The survey was pertinent to fishing which occurred in 1991. The number of anglers that indicated in the 1991 ASHS that they caught lake trout in the Tanana River drainage was limited (45 anglers). To boost sample size, lake trout anglers from 1987 to 1990 were included in the mailings. It was reasoned that some anglers who fished for lake trout in 1991 were not drawn in the sample for the 1991 ASHS, but could have been sampled sometime during 1987 to 1990. Mailings were sent to 153 households. Post cards announcing the survey were sent October 6, 1992 followed by the first mailing on October 14, 1992. The second mailing was posted on November 13, 1992.

Survey Description

The survey (Appendix A) consisted of eight questions concerning fishing for lake trout in lakes of the Tanana River drainage. All of the questions pertained to fishing during 1991 only. Questions numbered three through six sought information about fishing at lakes containing wild populations of lake trout. Questions seven and eight concerned the seasonal distribution of catch and effort at small lakes into which lake trout have been stocked.

The goal of the questionnaire was to obtain as much detailed information as possible without unnecessary complication. The desired responses for questions relating to the first objective (proportions of angler days by terminal gear, and season) were the total number of days of effort directed at catching lake trout by each household within each category. The desired responses for questions relating to the second objective (proportions of catch by terminal gear and season) were the total number of lake trout caught by each household within each category. Because the respondent/household was asked to remember all the lake trout caught during the entire year, the questions were worded in a way so as to not require too many recalls of exact dates and locations. The year was divided into two seasons: open-water and ice-cover. The seasons were selected for ease of recall by respondents. It was reasoned that by keeping the categories broad, the respondent would not become frustrated with the questionnaire and fail to return it.

Because of the potential bias associated with nonresponse in survey sampling, attempts to minimize nonresponse were made as suggested by Linsky (1975). First, a post card (Appendix B) announcing the survey was sent prior to the first mailing to minimize the expense of undeliverable surveys. Second, the questions were kept simple. Third, a cover letter (Appendix C) was attached to request cooperation and to explain the purpose of the study. Fourth, a

stamped, self addressed return envelope was included with each questionnaire. Fifth, a second mailing of letters and questionnaires was sent to all initial nonrespondents one month after the first mailing.

Data Analysis

In this study each parameter θ is estimated as a cluster proportion of the general form described by Cochran (1977):

$$\hat{\theta}_j = \frac{\sum_{i=1}^n a_{ij}}{\sum_{i=1}^n m_i} \quad (1)$$

$$V(\hat{\theta}_j) = \frac{\sum a_{ij}^2 - 2\hat{\theta}_j \sum a_{ij}m_i + \hat{\theta}_j^2 \sum m_i^2}{n(n-1) \left[\frac{\sum m_i}{n} \right]^2} \quad (2)$$

where:

$\hat{\theta}_j$ = the estimated proportion of category j (terminal gear type, season and population);

a_{ij} = the number of elements (fish or days) from household i that belong to category j;

m_i = the number of elements from household i; and,

n = the number of households in the sample.

Analysis of Bias

A problem inherent with all survey sampling is the effect of nonrespondents on the parameters being estimated. Analysis of nonresponse bias from the ASHS (M. J. Mills, Alaska Department of Fish and Game, Anchorage, personal communication) indicated that nonrespondents tended to fish less and catch fewer fish than did respondents. This tended to bias high the estimates of harvest and effort derived from the respondents. A correction factor was determined by examining the trend in responses from multiple mailings. Typically, the largest difference in response is noted between the first and second mailing. To determine the effects of nonresponse on this study, a second mailing of the same questionnaire was sent one month later to all initial nonrespondents. The various parameters and 95% confidence intervals were computed for each mailing and compared to determine if there was

significant bias in estimates due to nonresponse to the survey. If no significant differences in the estimates between mailings were detected, the nonresponse bias was considered unimportant and the data from both mailings were pooled.

This survey also has the added source of potential bias in that it is not a random sample. While the ASHS is a random sample of licensed anglers in the State of Alaska, the recipients of this survey had to have cooperated with ASHS in the past. As stated above, respondents usually tend to fish more and catch more fish than nonrespondents. But, in this study, the goal was to obtain information on the distribution of catch and effort among different terminal gears, and seasons rather than estimation of harvest or the amount of fishing effort. The assumption was made that while the harvest and effort of respondents from this survey may be biased high, the estimated proportions of how and when lake trout were caught would not be biased. In a similar study on burbot, Evenson and Hansen (1991) were able to test this assumption and found it valid.

RESULTS

Of the 153 surveys mailed, 129 (84%) were successfully delivered (Table 1). Of the delivered surveys, 87 (67%) were completed and returned. Forty of the households (46% of returned surveys) responded as having fished for lake trout in lakes of the Tanana River drainage in 1991. Response rates from the 1988 through 1990 ASHS mailing lists were similar (63% to 69%). The rate of response from the 1987 list was substantially lower than other groups. The highest percentage of delivered and returned surveys were from the 1991 group.

Respondents from the first mailing comprised most (66 of 87, 76%) of the returned survey questionnaires. Only 21 of the 63 (33%) households that received the second mailing responded.

Due to small sample sizes the tests comparing the mailings had very little power. The type I error was not corrected for experimentwise comparisons to increase the probability of detecting a difference. None of the 12 estimated parameters were different when responses from the two mailings were compared (Appendix D). Hence, the data from the two mailings were pooled. While not significantly different, there was a 21% difference in seasonal effort between the mailings. The respondents from the first mailing tended to expend more effort in open water than respondents to the second mailing who preferred to fish more in the ice-covered season. However, while the effort differed by 21%, the catch differed by only 5%.

Proportions of Effort

The greatest proportion of fishing effort directed at catching lake trout (0.827) occurred during the open water season (Table 2, Figure 1). The proportion of effort targeting lake trout during the open water season in wild populations was 0.795 (SE = 0.07) contrasted with 0.915 (SE = 0.05) in introduced populations. However, the seasonal proportion of effort directed at wild stocks and introduced populations was not significantly different ($Z = -1.39$, $P = 0.16$).

Table 1. Response rates to survey questionnaire.

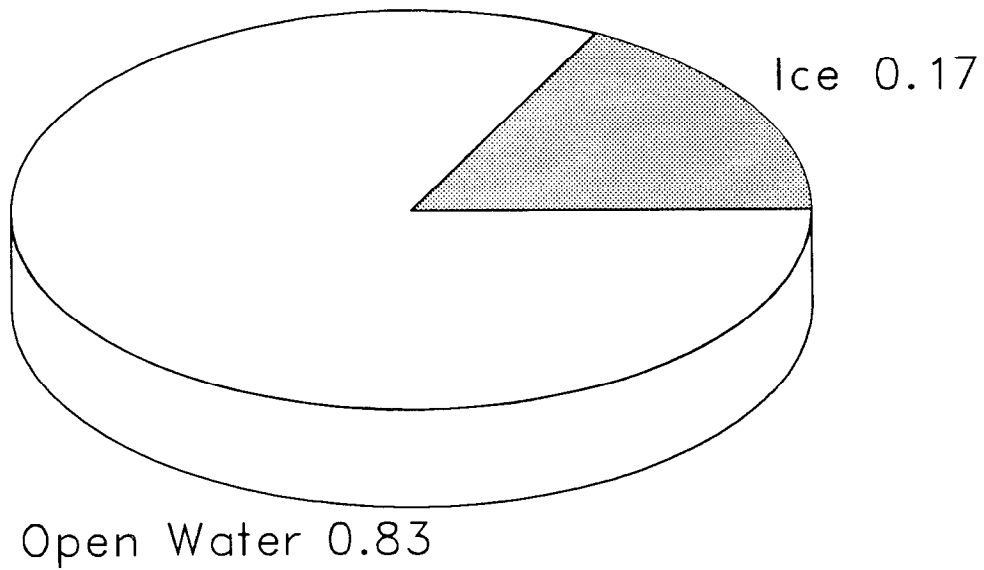
ASHS ^a Year	Number Mailed	Number Not Delivered	Number Delivered	Response First Mailing	Response Second Mailing	Total Response	Respondents who Fished in 1991
1987	9	2	7	2	0	2	2
% of Mailed		22	78	22	0	22	22
% of Delivered				29	0	29	29
1988	18	5	13	6	3	9	4
% of Mailed		28	72	33	17	50	22
% of Delivered				46	23	69	31
1989	50	9	41	20	7	27	9
% of Mailed		18	82	40	14	54	18
% of Delivered				49	17	66	22
1990	31	4	27	17	0	17	6
% of Mailed		13	87	55	0	55	19
% of Delivered				63	0	63	22
1991	45	4	41	21	11	32	19
% of Mailed		9	91	47	24	71	42
% of Delivered				51	27	78	46
Total	153	24	129	66	21	87	40
% of Mailed		16	84	43	14	57	26
% of Delivered				51	16	67	31

^a Households responding to ASHS as having fished for lake trout during each year.

Table 2. Proportion of fishing effort directed at wild and introduced lake trout stocks during ice-covered and open-water seasons in lakes of the Tanana River drainage.

Stock	Season	Number of Respondents	Number of Days	Proportion	Variance	L95	U95
Introduced	Ice-Covered		8	0.085	0.003	0	0.20
	Open-Water		86	0.915	0.003	0.80	1
	Total	12	94				
Wild	Ice-Covered		54	0.205	0.004	0.07	0.33
	Open-Water		210	0.795	0.004	0.67	0.93
	Total	28	264				
Both	Ice-Covered		62	0.173	0.004	0.05	0.30
	Open-Water		296	0.827	0.004	0.70	0.95
	Total	40	358				

Proportion of Fishing Effort By Season



Proportion of Catch By Season

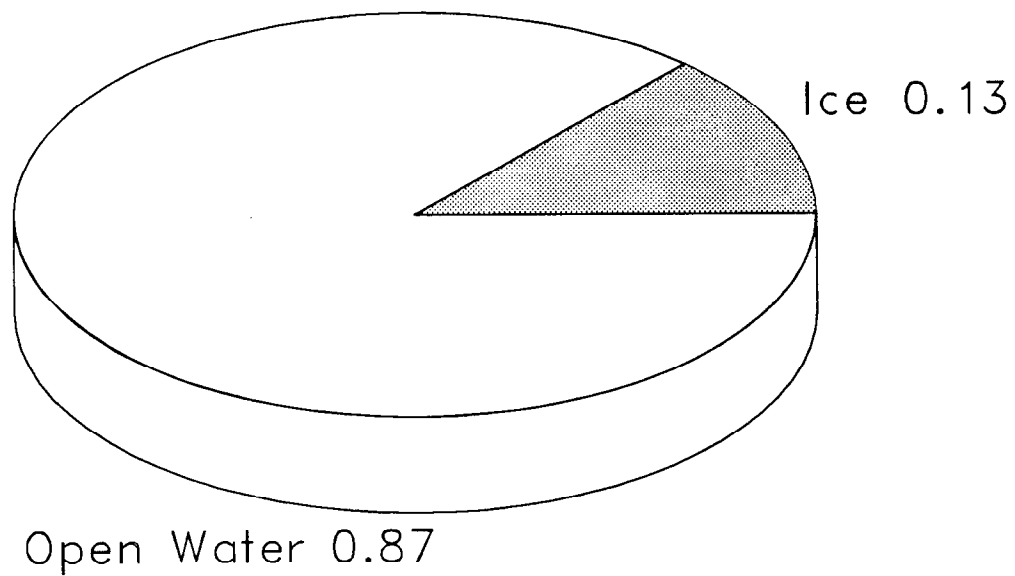


Figure 1. Seasonal distribution of fishing effort and catch of wild and introduced lake trout in lakes of the Tanana River drainage in 1991.

Proportions of Catch

Consistent with the results concerning fishing effort, the greatest proportion (0.868) of lake trout were caught during the open water season (Table 3, Figure 1). The proportion of lake trout caught during the open water season was not significantly higher for wild stocks (0.893) than for introduced populations (0.821; $Z = -0.07$, $P = 0.47$).

Information on the use of baited or unbaited terminal gear was obtained only from catch of wild stocks of lake trout. The proportion of lake trout caught with baited terminal gear was significantly higher ($Z = 3.7$; $P = 0.0001$) during the ice-covered season (0.545; $SE = 0.10$) than during the open-water period (0.077; $SE = 0.04$; Table 4, Figure 2). During open water season the greatest proportion (0.923) of the lake trout were caught with unbaited lures (Table 4).

DISCUSSION

This study was undertaken to obtain information on the distribution of effort and catch between seasons, and the kinds of terminal gear used by successful lake trout anglers. The results should provide direction to managers attempting to draft regulations which would be effective at reducing harvest of lake trout in critical populations in the Tanana drainage.

No significant bias due to nonresponse to the questionnaire was detected but sample sizes were small resulting in very low power of the test used. However, even if the estimates of the proportional seasonal effort and catch were biased, the recommendations for regulations that follow would not change. For both the first and second mailings, most effort and catch occurred during the open water season and most fish were caught without bait.

Winter season closures have been effective at reducing annual harvest in recreational lake trout fisheries in other localities (Olver 1988). But, in the Tanana drainage, only 13% (11% on wild stocks) of the annual catch and 17% (20% on wild stocks) of the annual effort came from the ice-covered season during 1991. These results indicate that anglers fishing during the ice-covered season are relatively less successful than are open-water fishermen. Hence, a regulation closing lakes in the Tanana drainage during the winter months would likely have a minimal effect on annual harvest.

Restrictions on the use of bait have also been proposed for reducing the harvest of lake trout. Although most (55%) lake trout caught in the winter were caught with bait, only 13% of the annual lake trout catch was taken with baited lures. Eliminating baited lures would therefore have only a limited effect on annual harvest.

In order to be effective at limiting lake trout harvest in the Tanana drainage, regulations should be directed at controlling fishing effort during the open water season. Most lake trout fishing appears to occur at the beginning and end of the open water period (Redick 1967). Spring and fall closures would be likely to have a significant effect on harvest. Where 18 inch minimum length limit restrictions are in effect, larger length limits might achieve greater control of the age and size structure of the spawning

Table 3. Proportion of catch of wild and introduced lake trout from Tanana waters during ice-covered and open-water seasons, 1991.

Stock	Season	Number of Respondents	Number of Fish	Proportion	Variance	L95	U95
Introduced	Ice-Covered		19	0.179	0.016	0	0.43
	Open-Water		87	0.821	0.016	0.57	1
	Total	12	106				
Wild	Ice-Covered		22	0.107	0.002	0.01	0.20
	Open-Water		183	0.893	0.002	0.80	0.99
	Total	28	205				
Both	Ice-Covered		41	0.132	0.002	0.04	0.22
	Open-Water		270	0.868	0.002	0.78	0.96
	Total	40	311				

Table 4. Proportion of wild lake trout catch by season and terminal gear from Tanana drainage waters, 1991.

Season	Terminal Gear	Number of Households	Number of Fish	Proportion	Variance	L95	U95
Ice-Covered	Baited		12	0.545	0.009	0.35	0.74
	Unbaited		10	0.455	0.009	0.26	0.65
	Total	28	22				
Open-Water	Baited		14	0.077	0.002	0	0.16
	Unbaited		164	0.923	0.002	0.84	1
	Total	28	177				

Proportion of Catch By Season and Gear

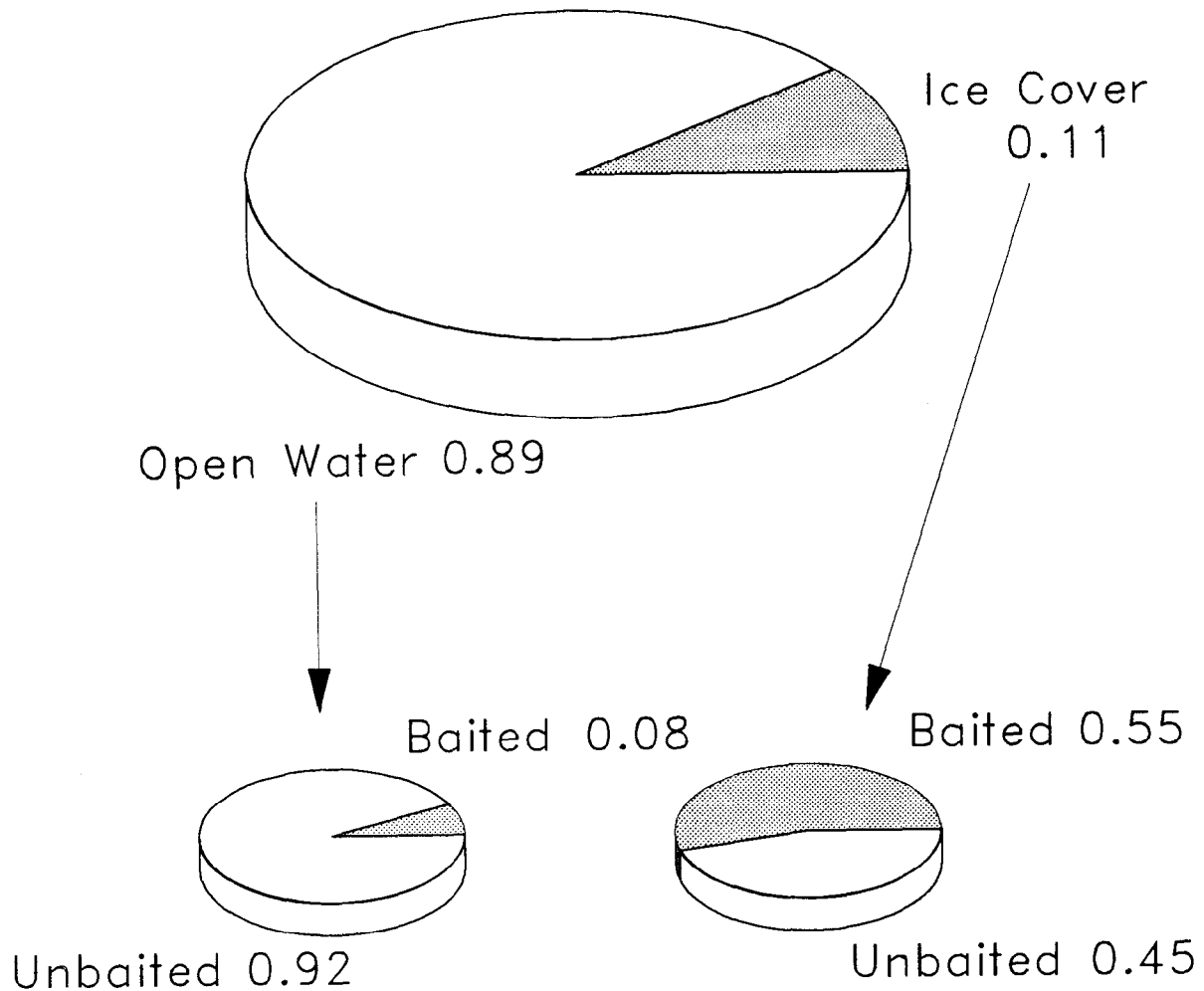


Figure 2. Proportion of catch of wild lake trout from two seasons and with baited and unbaited lures in lakes of the Tanana River drainage in 1991.

stocks, or be used to tailor fisheries to specific objectives (e.g. trophy fish). Reduction in the daily bag limit from two to one fish will reduce harvest to varying degrees. Catch rates for lake trout are low; most anglers at Fielding and the Tangle Lakes caught zero (65%) or one fish (27%) during a day's fishing (Burr 1986). The effect of changing only the daily bag limit is therefore likely to be minimal. Ultimately, it is amount of fishing effort directed at lake trout which determines fishing mortality and it is effort that must be controlled.

SUMMARY

This investigation found that most of the fishing effort for lake trout occurred during open water season. Similarly most of the catch and presumably the harvest of lake trout in the Tanana River drainage in 1991 took place in the open water fishery. Nearly all of these fish were caught with unbaited lures. Managers seeking to reduce effort and harvest on lake trout stocks should concentrate their efforts on fishing which takes place during the open water season. In addition, restricting the use of bait is unlikely to have a significant effect on harvest.

ACKNOWLEDGEMENTS

We would like to thank the anglers that took the time to answer the postal survey; without their continued assistance the research would not be possible. Special thanks to Gail Heinemen and Gary Fidler of Sport Fish RTS for their help with names and addresses of anglers and with other valuable information from the Alaska Statewide Harvest Survey data base. Thanks to Peggy Merritt and John Clark for support during all phases of the project. This project was funded by the U. S. Fish and Wildlife Service through the Federal Aid in Fish Restoration Act.

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APPENDIX A

Map of the Tanana Area and Questionnaire

LAKE TROUT FISHING IN THE TANANA RIVER DRAINAGE
QUESTIONNAIRE

- 1) Did you or members of your household fish for lake trout in 1991 within the Tanana River Drainage? Refer to map to determine drainage boundaries.

YES - go to next question
NO - please return the questionnaire in the self
addressed envelope

- 2) Did you or members of your household fish for lake trout at Fielding, Rock or Ptarmigan lakes or at lakes along the Denali Highway, such as the Tangle lakes?

YES - go to next question
NO - go to question 7

- 3) How many days did you or members of your household fish for lake trout in the lakes listed above during 1991?

in open water _____
through ice _____

- 4) How many lake trout did you or members of your household catch in the lakes listed above during 1991?

in open water _____
through ice _____

- 5) What percentage of the lake trout caught in OPEN WATER in the lakes listed above were caught using the following gear types? Please circle the appropriate percentage.

unbaited lures

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

baited lures

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

- continued -

Appendix A. (Page 3 of 3).

- 6) What percentage of the lake trout caught THROUGH THE ICE in the lakes listed above were caught using the following gear types?

unbaited lures

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

baited lures

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

- 7) How many days did you or members of your household fish for lake trout in lakes or ponds in the Tanana River drainage other than those lakes listed in question 2?

in open water _____
through ice _____

- 8) How many lake trout did you or members of your household catch in lakes or ponds in the Tanana River drainage other than those lakes listed in question 2?

in open water _____
through ice _____

APPENDIX B
COPY OF POSTCARD ANNOUNCING SURVEY

Appendix B. Copy of postcard announcing survey.

Dear Alaskan Angler,

In a few days you will receive a questionnaire concerning lake trout fishing in the Tanana River Drainage. Please take a few minutes to fill out and return the survey on arrival. Thank you.

Sincerely,

John Burr
Fishery Biologist
Sport Fish Division
(907) 456-8819

APPENDIX C
COPY OF QUESTIONNAIRE COVER LETTERS

Appendix C. Copy of questionnaire cover letters.

October 12, 1992

Dear Alaskan Angler,

Thank you for responding to the Statewide Harvest Survey (in the past). Your assistance has been invaluable in maintaining the quality of Alaska's recreational fishing. To improve that quality, we would appreciate your further assistance. The Sport Fish Division of the Alaska Department of Fish and Game is conducting research on lake trout fishing in lakes in the Tanana Drainage. The purpose of this study is to determine how and when lake trout are harvested. Your name was selected from a list of anglers who answered the Statewide Harvest Survey and listed harvesting lake trout from the Tanana River Drainage.

The attached questionnaire inquires about all lake trout fishing you did during 1991 (Jan. 1 - Dec. 31) in the Tanana River Drainage. Even if you and other anglers in your household fished very little or not at all during 1991, your answers are important in making the survey accurate and complete. Would you please take a few minutes to complete this questionnaire? Your individual answers will remain confidential. Only summary results will be made public.

If you have any questions or comments concerning this survey, please contact me. Thank you for your help.

Sincerely,

John Burr
Fishery Biologist
Sport Fish Division
(907) 456-8819

-continued-

November 13, 1992

Dear Alaskan Angler,

We have not yet received your completed questionnaire(s) on lake trout fishing in the Tanana Drainage. Even if you and other anglers in your household fished very little or not at all for lake trout during 1991, your responses to this survey are important in making our results accurate. Would you please take a few minutes to answer the questionnaire.

If you have already returned your questionnaire, please disregard this letter and accept our thanks.

Sincerely,

John Burr
Fishery Biologist
Sport Fish Division
(907) 456-8819

APPENDIX D

Appendix D. Comparison of upper and lower 95% confidence intervals (U95 and L95) of proportions estimated from the postal questionnaire between two separate mailings.

Mailing	Parameter	Proportion	Variance	L95	U95
First	Wild\Effort\Ice-Covered	0.10448	0.002414	0.008	0.201
Second	Wild\Effort\Ice-Covered	0.30769	0.004984	0.169	0.446
First	Wild\Effort\Open-Water	0.89552	0.002414	0.799	0.992
Second	Wild\Effort\Open-Water	0.69231	0.004984	0.554	0.831
First	Wild\Catch\Ice-Covered	0.09353	0.003994	0	0.217
Second	Wild\Catch\Ice-Covered	0.13636	0.008207	0	0.314
First	Wild\Catch\Open-Water	0.90647	0.003994	0.783	1
Second	Wild\Catch\Open-Water	0.86364	0.008207	0.686	1
First	Stocked\Effort\Ice-Covered	0.05128	0.001725	0	0.133
Second	Stocked\Effort\Ice-Covered	0.25	0.97656	0	1
First	Stocked\Effort\Open-Water	0.94872	0.001725	0.867	1
Second	Stocked\Effort\Open-Water	0.75	0.97656	0	1
First	Stocked\Catch\Ice-Covered	0.17647	0.023053	0	0.474
Second	Stocked\Catch\Ice-Covered	0.19048	0.0645	0	0.688
First	Stocked\Catch\Open-Water	0.82353	0.023053	0.526	1
Second	Stocked\Catch\Open-Water	0.80952	0.0645	0.312	1
First	Catch\Open-Water\Baited	0.06746	0.001875	0	0.152
Second	Catch\Open-Water\Baited	0.10117	0.009020	0	0.287
First	Catch\Open-Water\Unbaited	0.93254	0.001875	0.848	1
Second	Catch\Open-Water\Unbaited	0.89883	0.009020	0.713	1
First	Catch\Ice-Covered\Baited	0.46154	0.002641	0.361	0.562
Second	Catch\Ice-Covered\Baited	0.66667	0.052675	0.217	1
First	Catch\Ice-Covered\Unbaited	0.53846	0.002641	0.438	0.639
Second	Catch\Ice-Covered\Unbaited	0.33333	0.052675	0	0.783

